Poster Abstract: Traffic Caution System for Pedestrian Safety

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I. Introduction

According to the 2013 annual report file by the Fatality Analysis Reporting System (FARS), 14 percent of all traffic fatalities and an estimated 3 percent of those injured in traffic crashes were pedestrians [1]. The report defined four environmental characteristics (i.e., land use, pedestrian location, light condition, and time of day and season) for the pedestrian fatalities occurred in 2013 and shows that the fatal pedestrian crashes occurred more in urban, non-intersection, and dark areas. Fatal pedestrian crashes are about 9 times smaller when both drivers and pedestrians have a blood alcohol concentration (BAC) of .08 gram per deciliter (g/dL) than when both drivers and pedestrians have a BAC of .00 g/dL. It means that the reasons for fatal pedestrian crashes are a lack of driver's pedestrian detection and road attentiveness (e.g., ped. behind obstacle, and driver using smartphone.), and a lack of pedestrian's road attentiveness (e.g., a ped. using smartphone or earphones, and a bicycle to cross road without looking behind the rider.). There are four approaches for improving pedestrian safety: 1) infrastructure design enhancement, 2) passive safety systems involving vehicle design, 3) active safety systems based on pedestrian detection, and 4) collision prediction [2]. The infrastructure design enhancement has been mainly done at the intersection with many infrastructures (e.g., roadway lighting for pedestrian visibility.) but the fatal pedestrian crashes have occurred more in non-intersection areas due to low road attentiveness. The passive safety systems are manufactured hardwares (e.g., bumper.) and post-accident solutions without precaution. For the collision prediction, it is important to model pedestrian motion accurately but it is hard to predict behavior of pedestrian with highest BAC (e.g., abnormal pedestrian.). The active safety systems are based on pedestrian detection to give a warning signal about a fatal pedestrian crash to a driver using a location of detected pedestrian. For the systems, it is important to detect pedestrian using various sensors (e.g., visible light imaging, infrared imaging, time of flight sensors, and multiple types of sensors.). Vehicle-mounted sensors are useful to detect pedestrians on the road but visibility from the vehicle is limited (e.g., occluded object, and curve.). So, infrastructure-based system is more useful in the limited visibility but mounting infrastructure is expensive. Our approach is active safety system based on pedestrian detection. This paper proposes a traffic caution system for pedestrian safety whose objective is to give a warning using visual effect to both driver and pedestrian to solve a lack of driver's and pedestrian's road attentiveness as shown in Fig.1. Our contributions are as follows: 1) pedestrian detection and vehicle speed estimation using low cost sensors, 2) spontaneous participation of a driver for risk awareness according to visual effects (e.g., if LEDs are turned on, the driver puts the phone down.), and 3) improvement of road attentiveness of a pedestrian and a driver using visual effects (i.e., high attentiveness on the road if LEDs are red, and moderate attentiveness on the road if LEDs are yellow.).

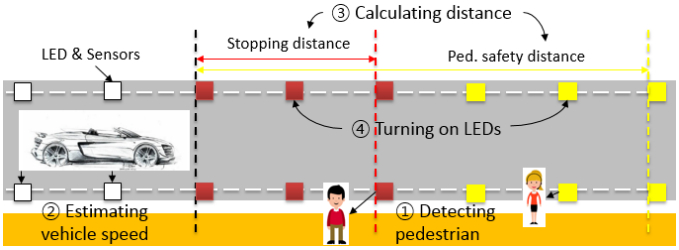

Figure 1 System Descriptions

II. System Descriptions & Conclusion

Our system is an active safety system based on pedestrian detection to give a warning for precaution of accident to both driver and pedestrian. This system has largely four steps: 1) detecting pedestrian, 2) estimating vehicle speed, 3) calculating distance, and 4) turning on LEDs. This system detects pedestrian using measurements of distance and speed through sensors (e.g., microwave radar, infrared distance, and ultrasonic distance sensor). We assume that the average speed and maximum speed of pedestrian are 1.4m/s, and 2.5m/s, respectively. If speed of an object on the road is larger than maximum speed of pedestrian, we define the object as a vehicle (i.e., this system distinguishes whether an object is pedestrian using the assumption for pedestrian speed). If there are a pedestrian, and a vehicle and the distance between the pedestrian and the vehicle is close to pedestrian safety distance, this system turns on the LEDs according to stopping distance and pedestrian safety distance [3]. If LEDs are turned on suddenly, the driver and the pedestrian will give more attention to the road condition. Therefore, the system will proactively prevent the possible fatal pedestrian crashes.

Acknowledgment

This research was supported in part by Global Research Laboratory Program (2013K1A1A2A02078326) through NRF, and the DGIST Research and Development Program (CPS Global Center) funded by the Ministry of Science, ICT & Future Planning.

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